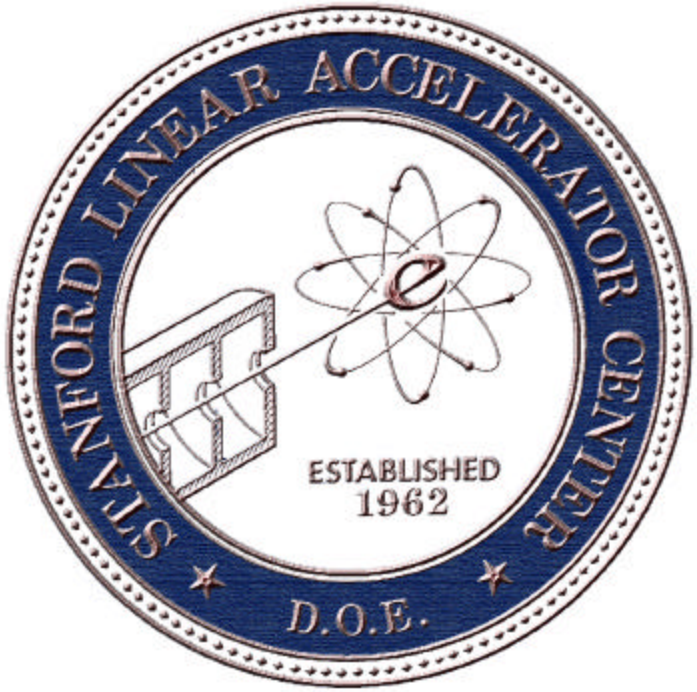
SLAC Update



Presentation by

Jonathan Dorfan, Director

at

HEPAP

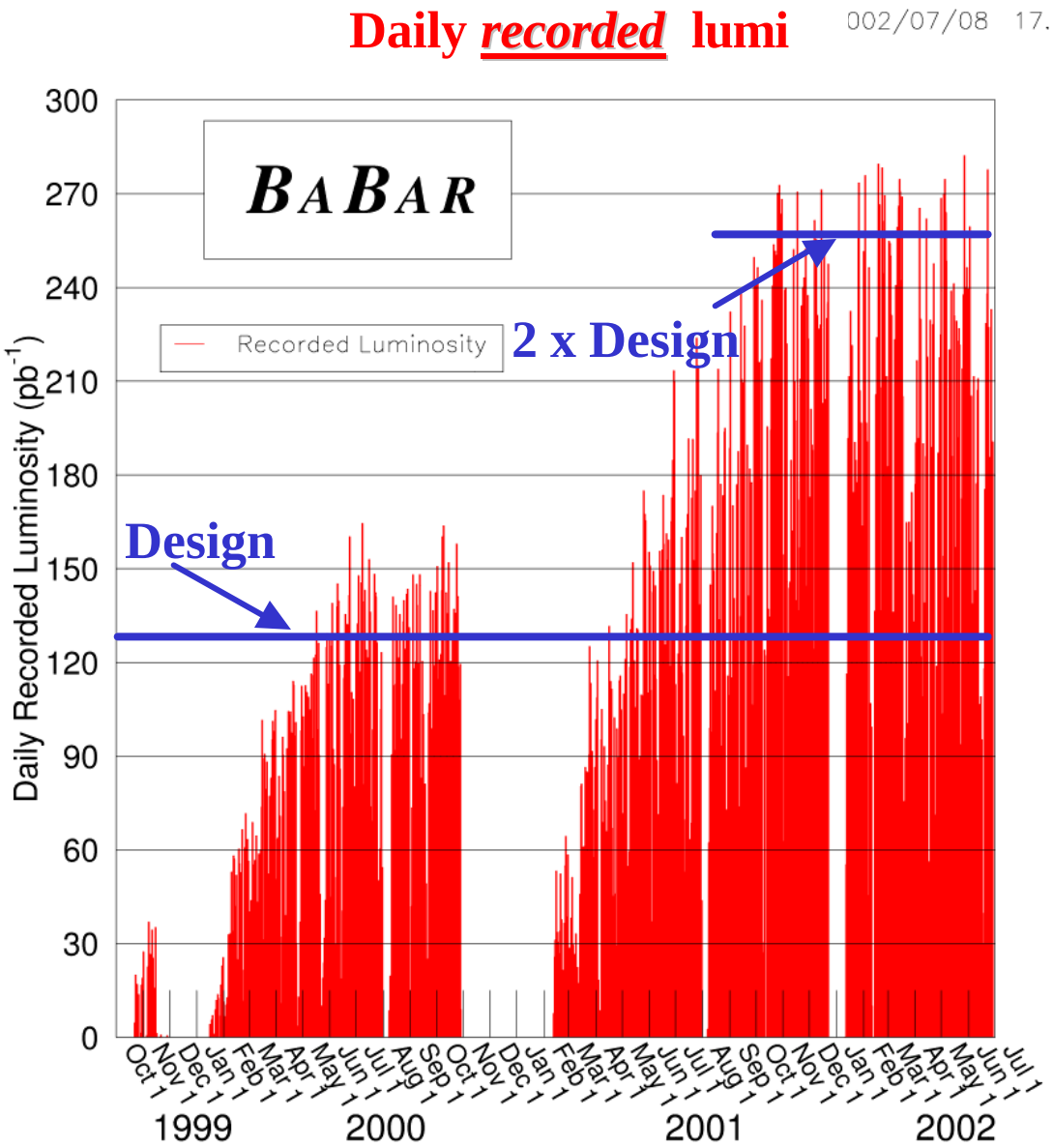
November 7, 2002

PEP-II and BABAR

- Run 2 concluded June 2002 with total integrated luminosity of 100 fb^{-1}
- 4 ½ month down time activities will be completed on-time Nov. 15, 2002 at which time we commence Run 3
  - PEP-II luminosity reach improved to 10^{34} cm^{-2} sec^{-1}
  - Several improvements to BABAR

PEPII / BABAR Performance

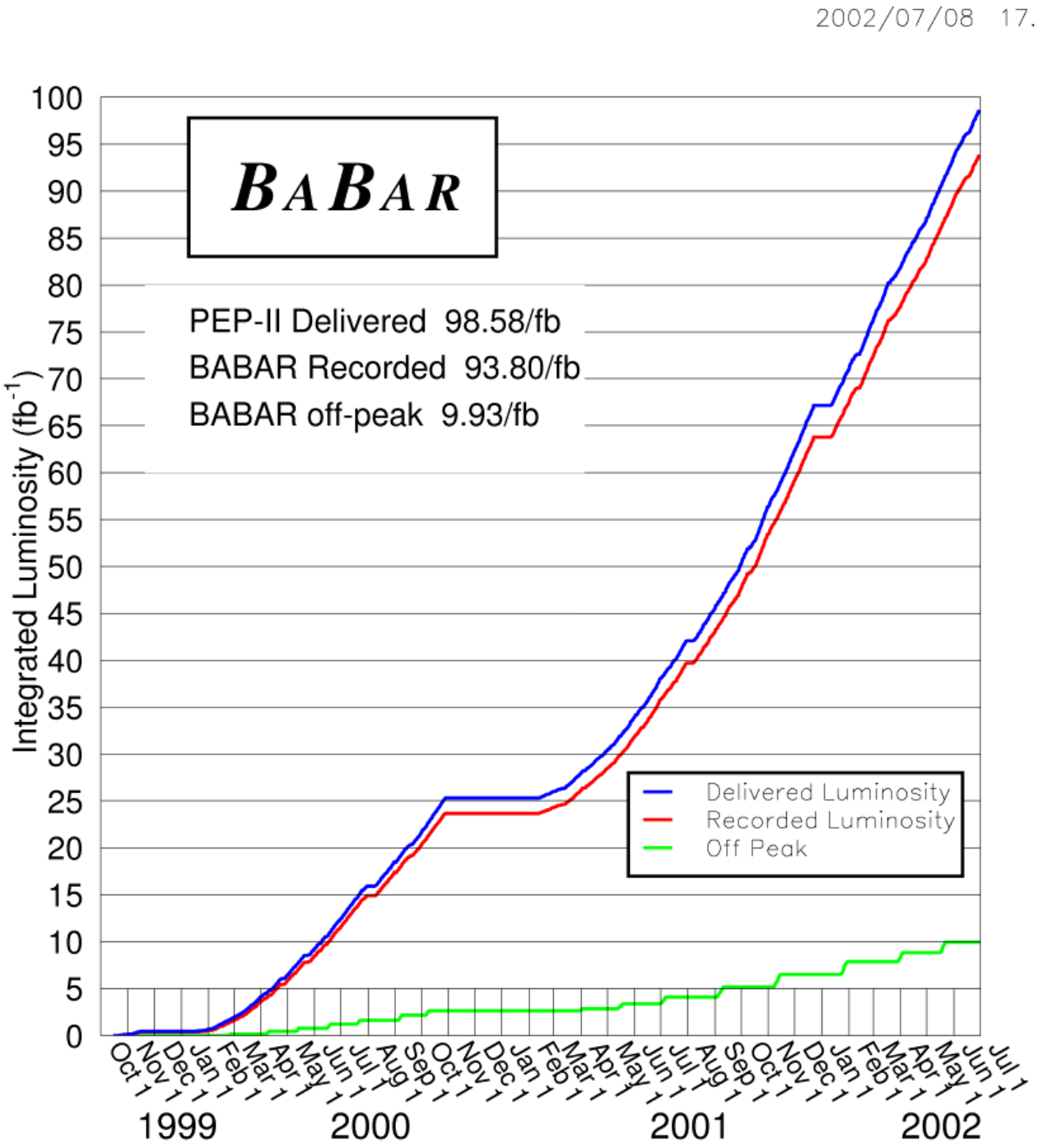
Daily *recorded* lumi



Records for recorded lumi

shift:	**105 pb^{-1}**
24 hrs:	**303**
Week:	**1790**
Month:	**6666**

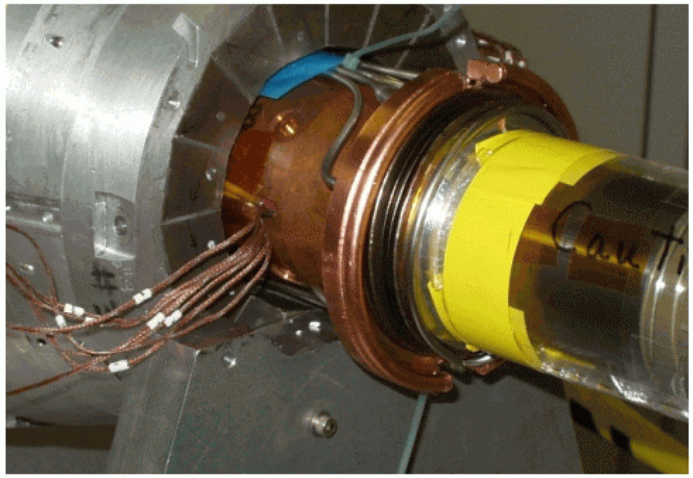
- Within 4 months of first BaBar collisions, setting world records for luminosity delivered
- Within first year, design goals for luminosity delivered to detector met and exceeded


2002/07/08 17.14
BABAR
PEP-II Delivered 98.58/fb
BABAR Recorded 93.80/fb
BABAR off-peak 9.93/fb
Integrated Luminosity (fb-1)
Delivered Luminosity
Recorded Luminosity
Off Peak
1999
2000
2001
2002

Interaction point improvements for reduced beam heating

- IP bellows cooling (air and water)
- New Q2 chamber
- New Q2 bellows
- New beam loss monitors
- Repaired vacuum valves
- > x5 improvement in beam heating capacity

Forward Vertex Chamber Bellows Cooling Installation

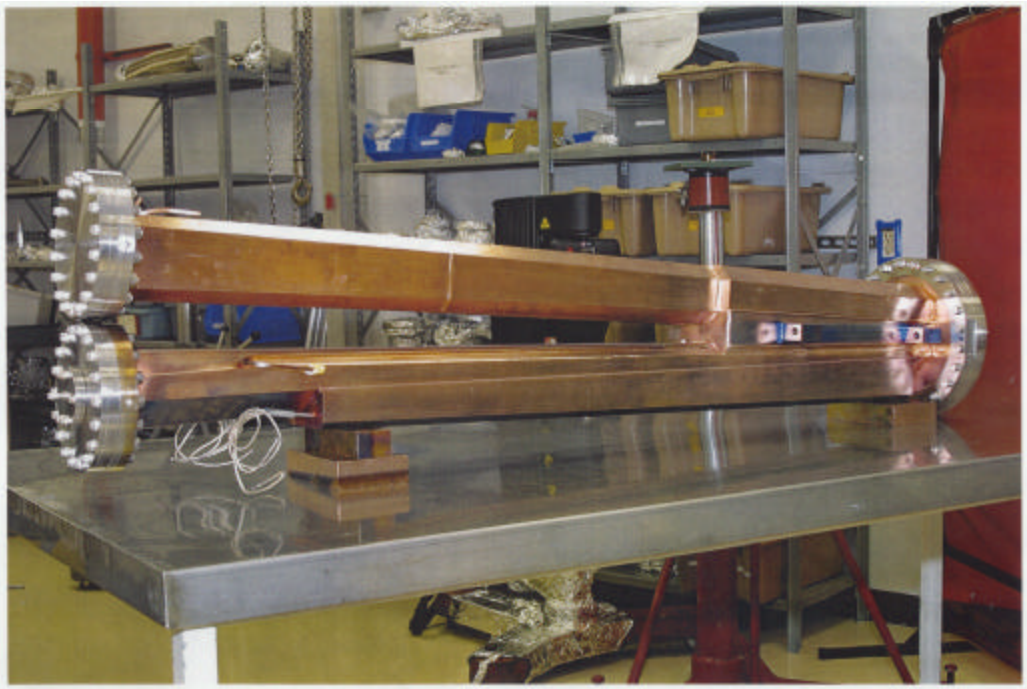


Higher Beam Currents

- Installed two new HER RF stations
- Commission one new LER RF station
- Shortened abort gap from 5% to 2.5%
- Improved cooling on bunch feedback kickers
- More shielding near LER IR collimators for backgrounds
- Plan to increase each beam current by x1.4

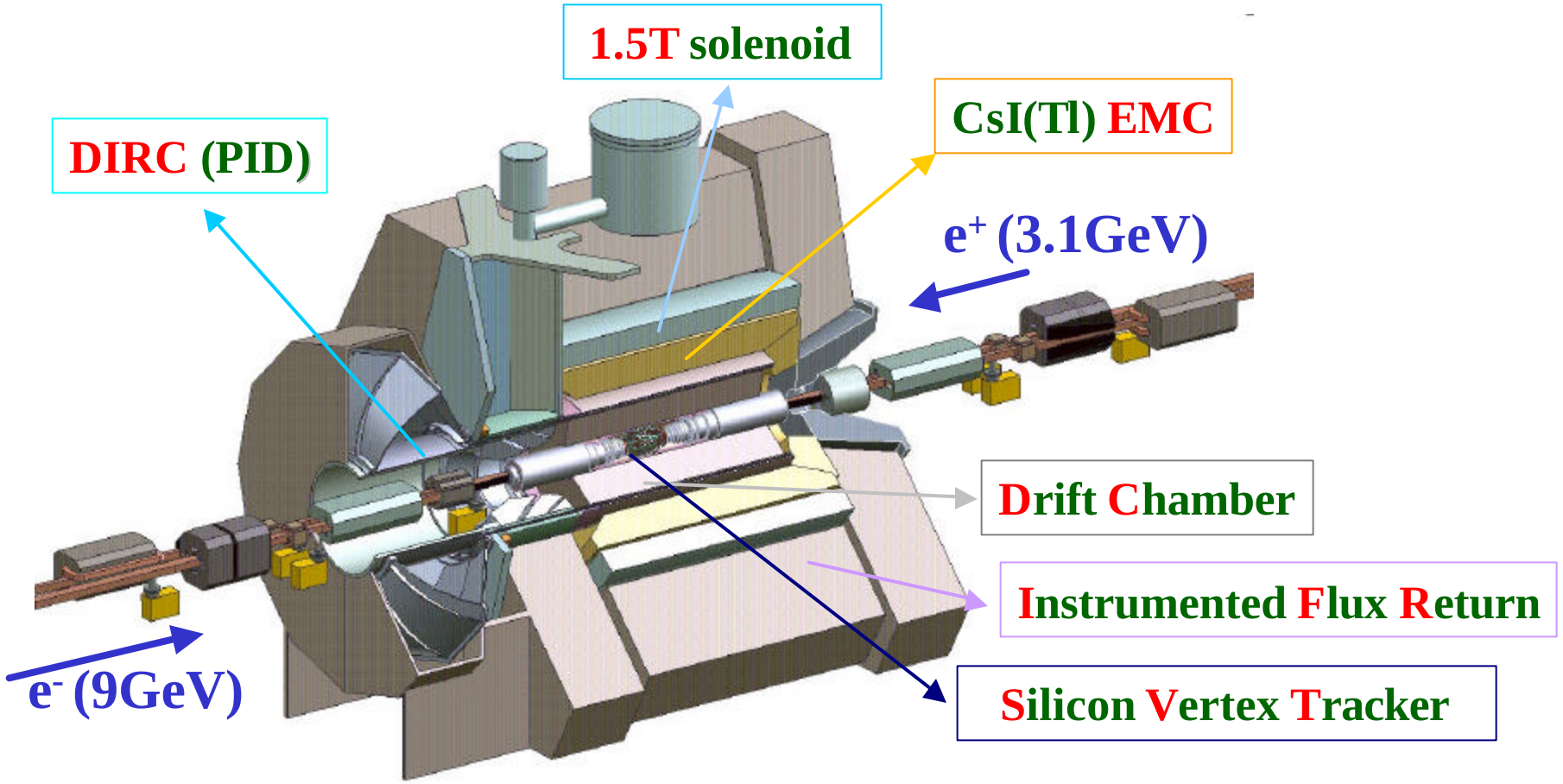
Lower ?$_y$* from 13 to 9 mm

- New x-y BPMs at sextupoles in both rings for improved steering
- New ring correction algorithms (MIA)
- Better IR coupling control with better lattice model
- Move horizontal tunes to near half integer
- Luminosity gain equals 13/9 or ~1.4



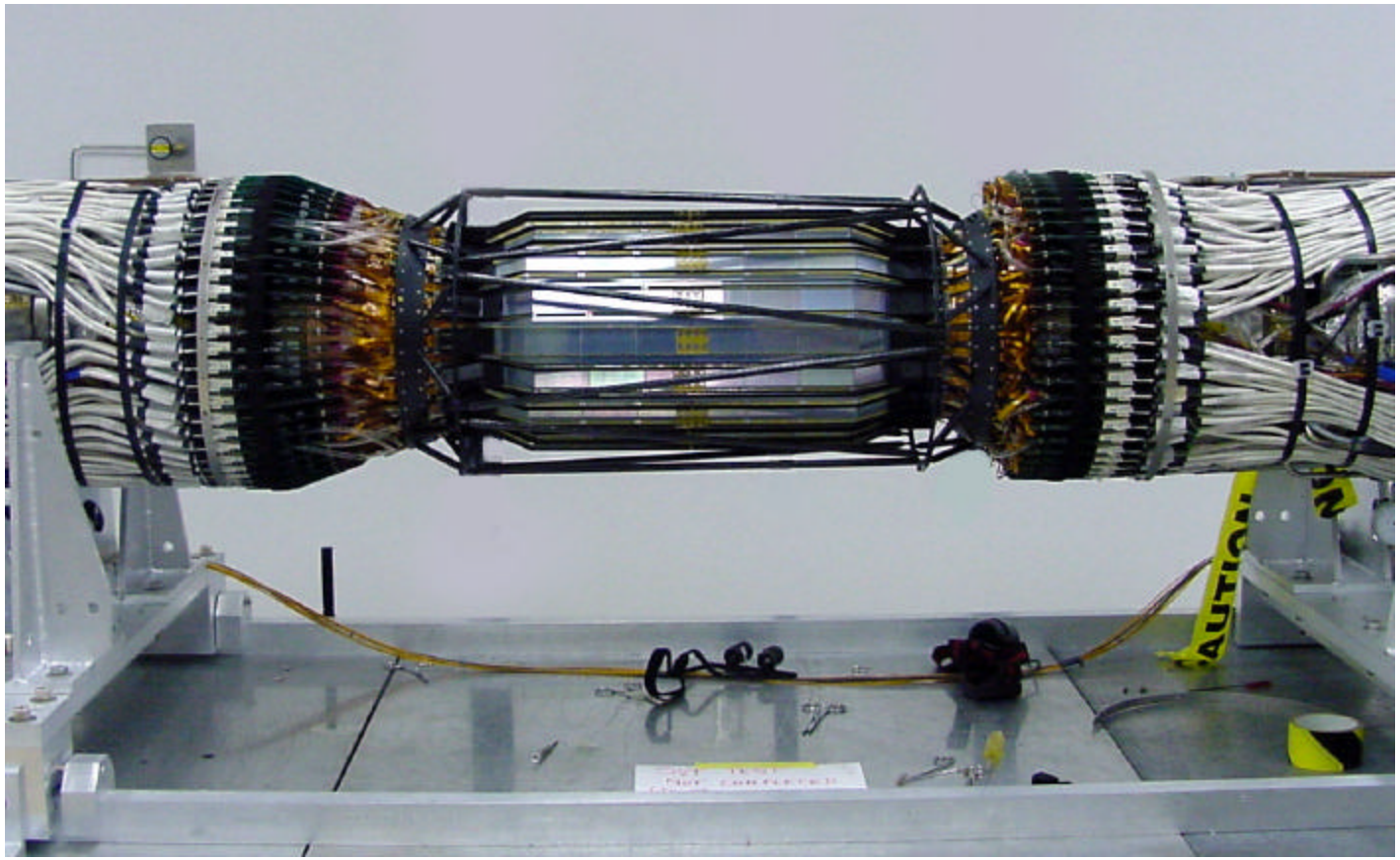
New PEPII forward Q2 vacuum chamber CRW_0415L, S.J.Metcalfe, 5/18/02

The BABAR Detector



- SVT: 97% efficiency, 15mm z resol. (inner layers, ? tracks)
- Tracking : ? $(p_T)/p_T = 0.13\% \; P_T$? 0.45%
- DIRC : K-? separation >3.4? for P<3.5GeV/c
- EMC: ? $_E/E = 1.33\% \; E^{-1/4}$? 2.1%

SVT Summer Shutdown Work

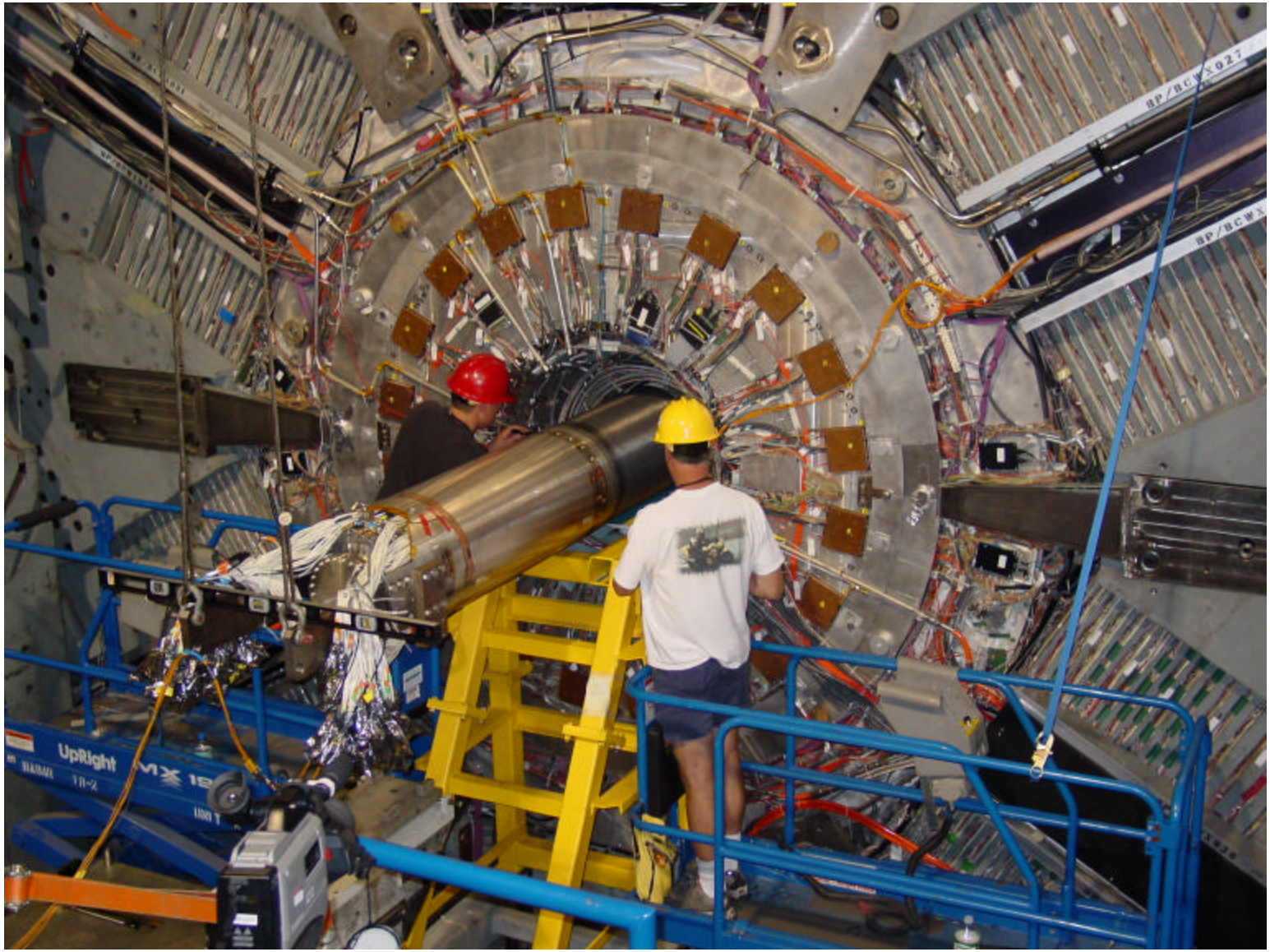


- SVT work performed by a team from Italy and US
- SVT was un-cabled, split in two halves and removed from the B1 magnets

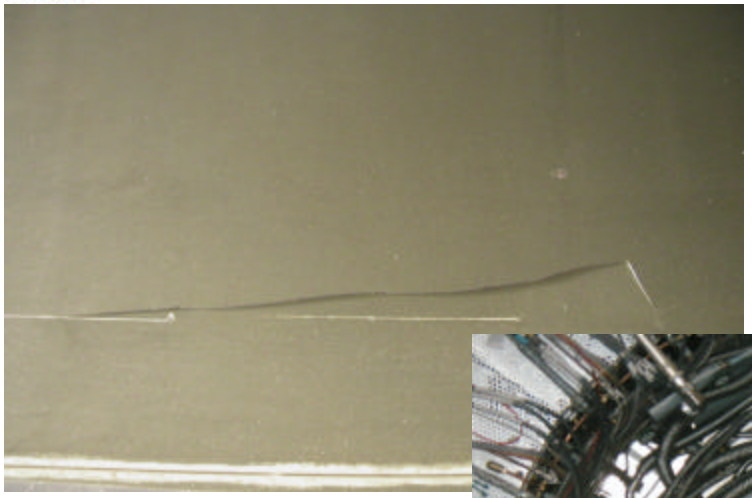
SVT Work

- Many electrical tests and visual inspections were performed. Identified the cause of the the 9 non functioning readout sections: mainly due to bad connections to the matching cards
- During the reassembly procedure we were able to
  - Fix six out of nine non functioning sections (non-functioning now: 3 of 208)
  - Secure better the connections at the matching cards
  - Improve the sealing of the IP and install a humidity control system
  - Re-terminate the backward cables
  - Install additional radiation sensors (diamond,CsI,quartz)
- No new non functioning read-out sections were introduced

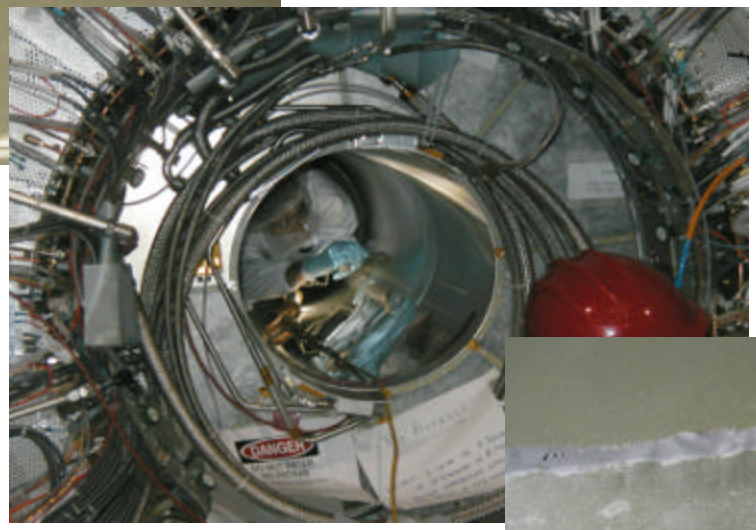
SVT & Support Tube Installation



DCH Damage and Repair, Summer 2002



- Support tube hit inner cylinder
- 6" x 1" crack in beryllium section
- No environmental contamination
- IC still about 7x structural load



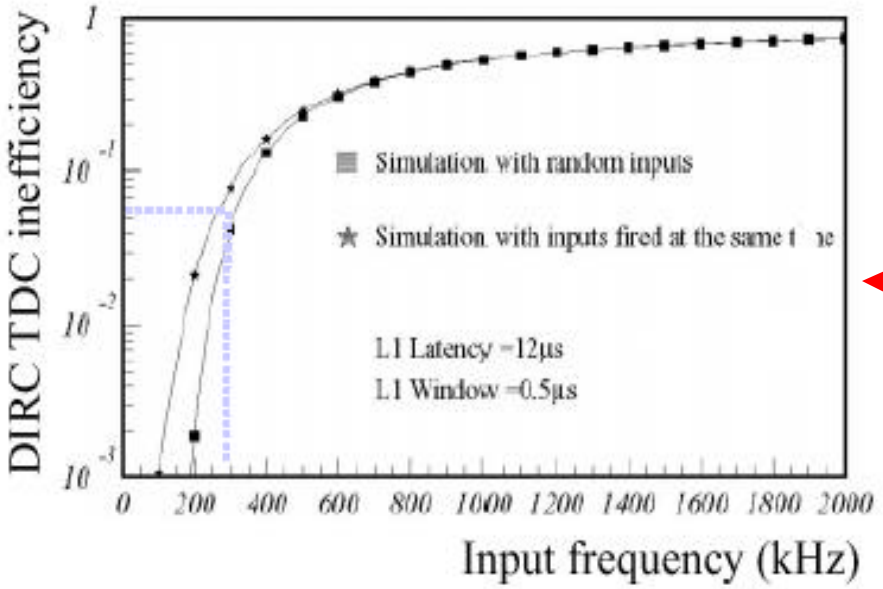
- Filled with epoxy
- Covered with Al

- Helium tight (< 50 ml/min)
- Electrically grounded
- 5 mm clearance to support tube
- No damage to nearby wires

DIRC shutdown main activity: TDC upgrade (French effort)

Issue: background rate versus luminosity:

→ **expectation: rate (kHz) ~ 530 at L=4.10^{34} cm^2/s**



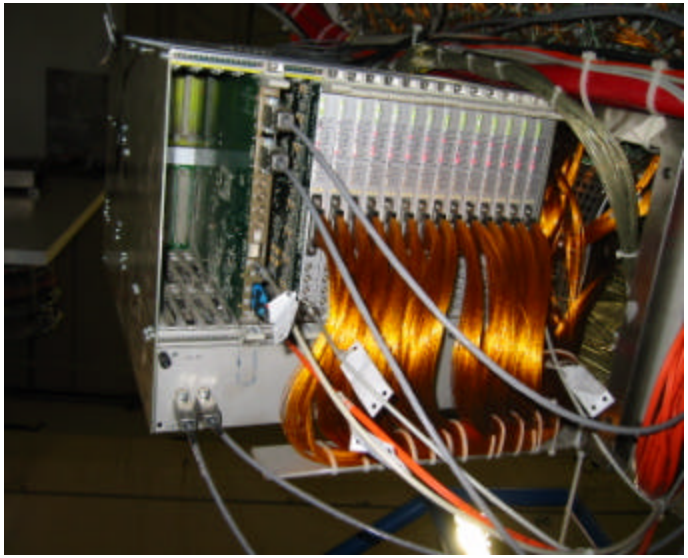
← **high inefficiency with current design**

? **New TDC design to allow small dead time up to 1 MHz rates**

- Binning=520ps, full scale=32? s
- Simultaneous Read and Write operations
- Counting inefficiency < 1% @1MHz
- Minimum time between 2 consecutive L1: 2.2 ? s

DIRC shutdown main activity: TDC upgrade

TDC chips: 12 (sectors) × 14 (Front End Boards) × 4 (chips)=672



Sector crate

Front end board

Boards: - removed and sent to external company for chips exchange

- re-coded and tested in test bench at SLAC

- re-installed in detector

↳ **fully tested with calibration data: OK**

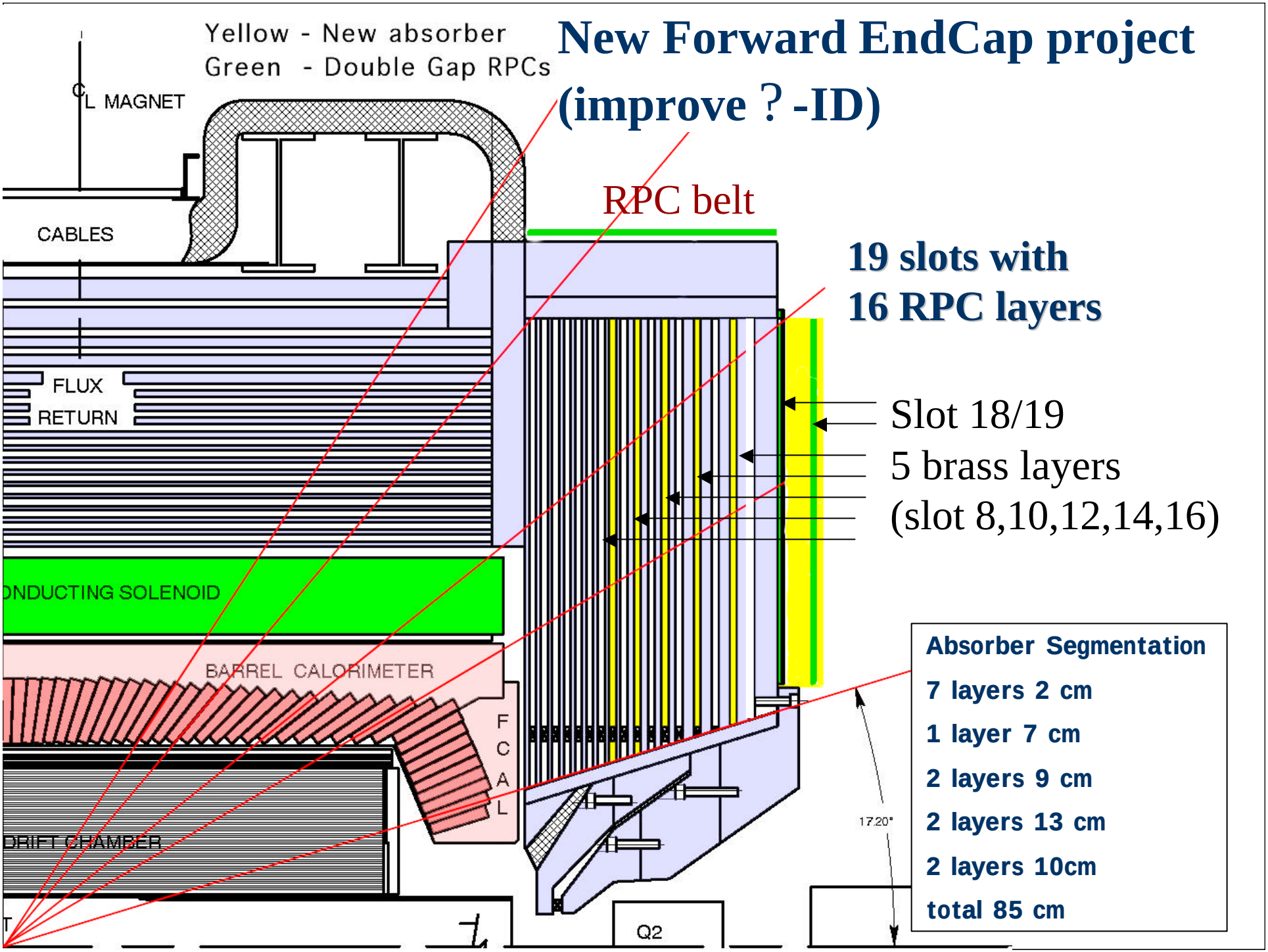
→ **TDC upgrade successful !**

DIRC shutdown main activity: TDC upgrade (III)

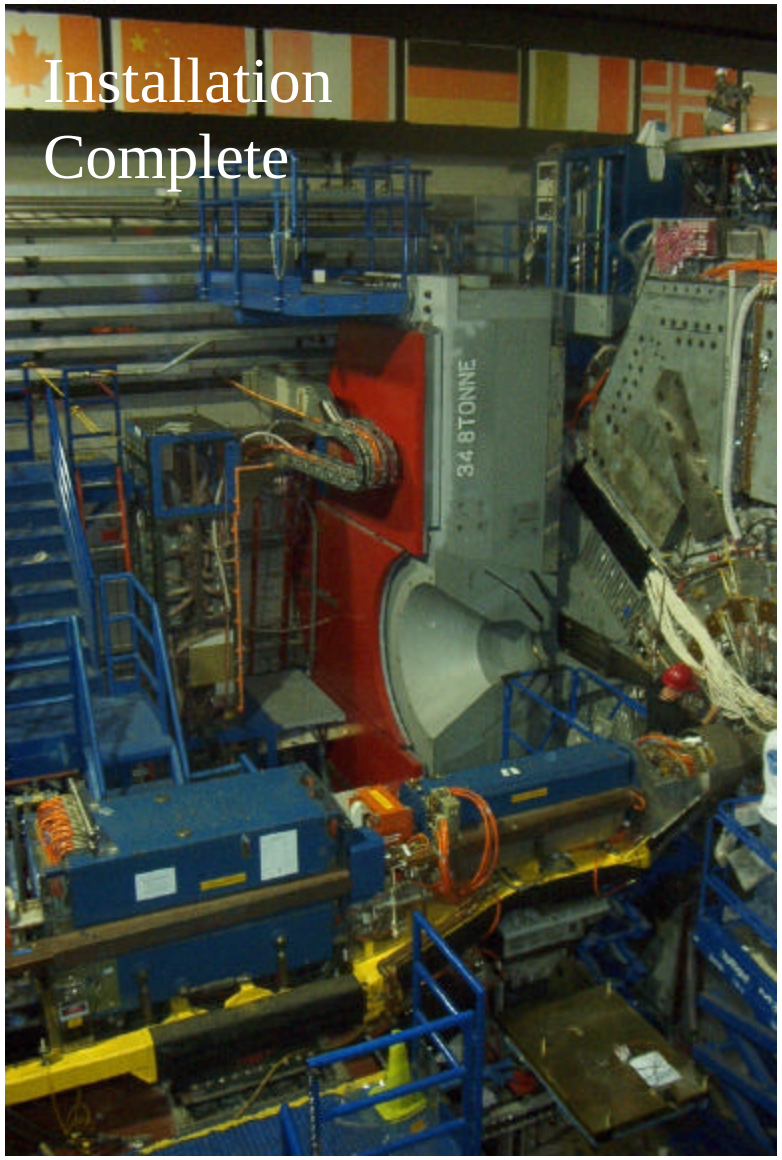
- **TDC fabrication: custom made at LPNHE (Paris)**
  - **Design review: May 4th 2001**
  - **First prototype: mid-October 2001**
  - **Second round of prototype : April 2002**
  - **Full production launched: April 2002**
  - **Chips sent to SLAC: September 18th 2002**
  - **Chips exchanged by company: October 2th 2002**
  - **Boards re-installed and fully tested in detector: October 11th 2002**

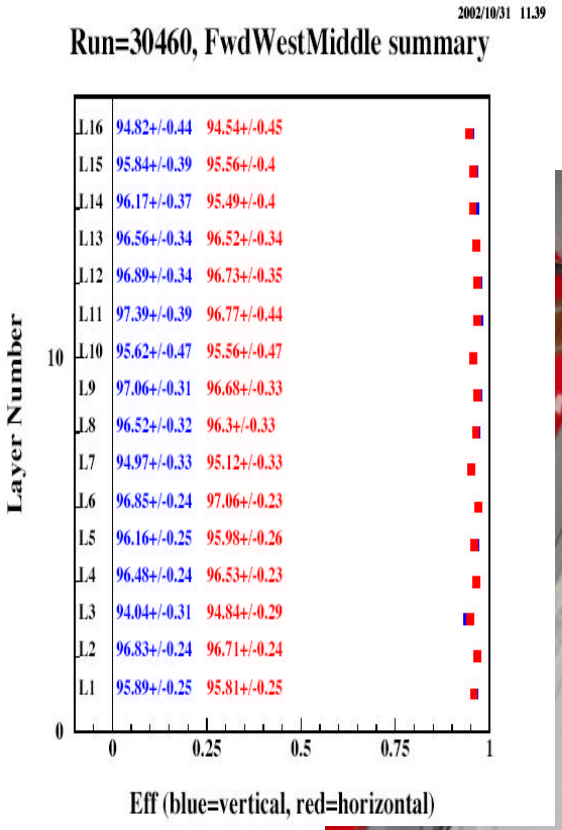
IFR Endcap Upgrade

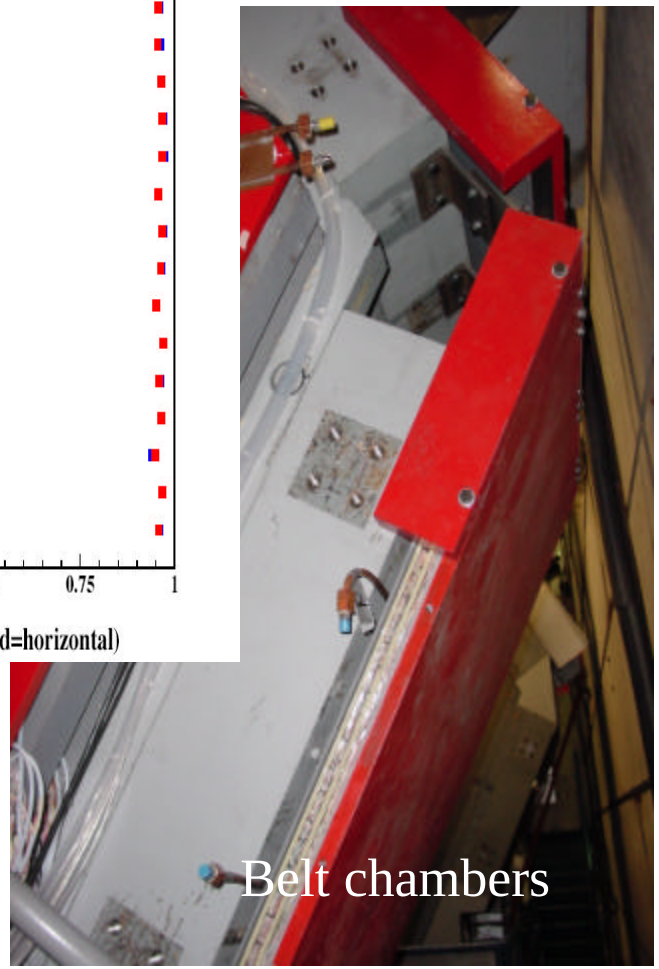
- **Improve pion contaminationn for tightly identified muons from 2.36% to < 1%**
- **Replace dying RPCs with new chambers that have been carefully QC'd**
- **INFN provides new, improved RPCs**
- **US provides brass absorber, improved HV distribution system, improved gas distribution system**
- **INFN & US: extensive manpower & engineering contributions**


Yellow - New absorber
Green - Double Gap RPCs
New Forward EndCap project
(improve ? -ID)
L MAGNET
CABLES
RPC belt
19 slots with
16 RPC layers
FLUX
RETURN
Slot 18/19
5 brass layers
(slot 8,10,12,14,16)
ONDUCTING SOLENOID
BARREL CALORIMETER
F
C
A
L
DRIFT CHAMBER
17.20°
Q2
Absorber Segmentation
7 layers 2 cm
1 layer 7 cm
2 layers 9 cm
2 layers 13 cm
2 layers 10cm
total 85 cm

Forward Endcap: Installation Complete







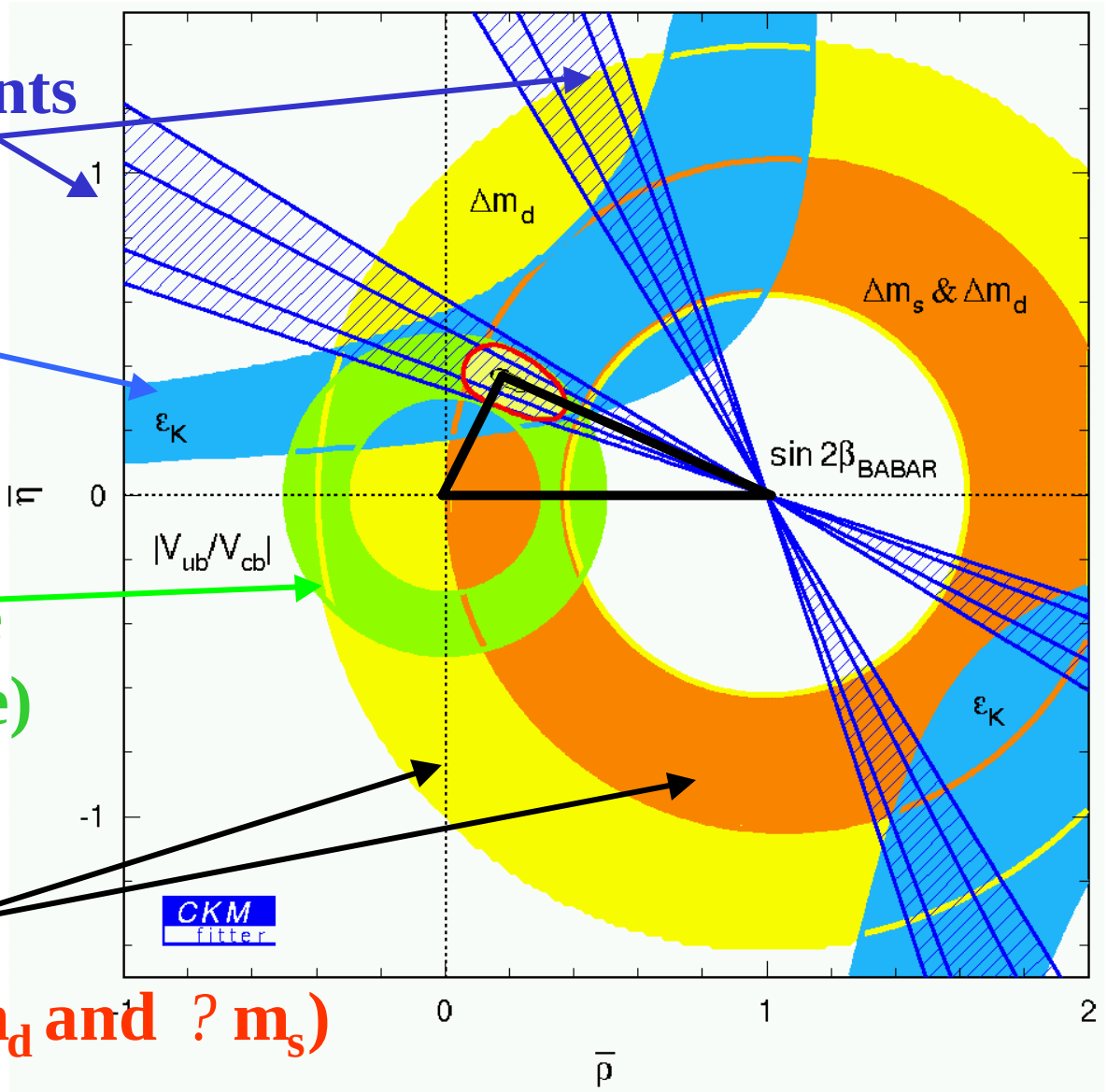
sin(2?) — Defining our Understanding

sin(2?) constraints from BABAR

CP violation in *K* decays

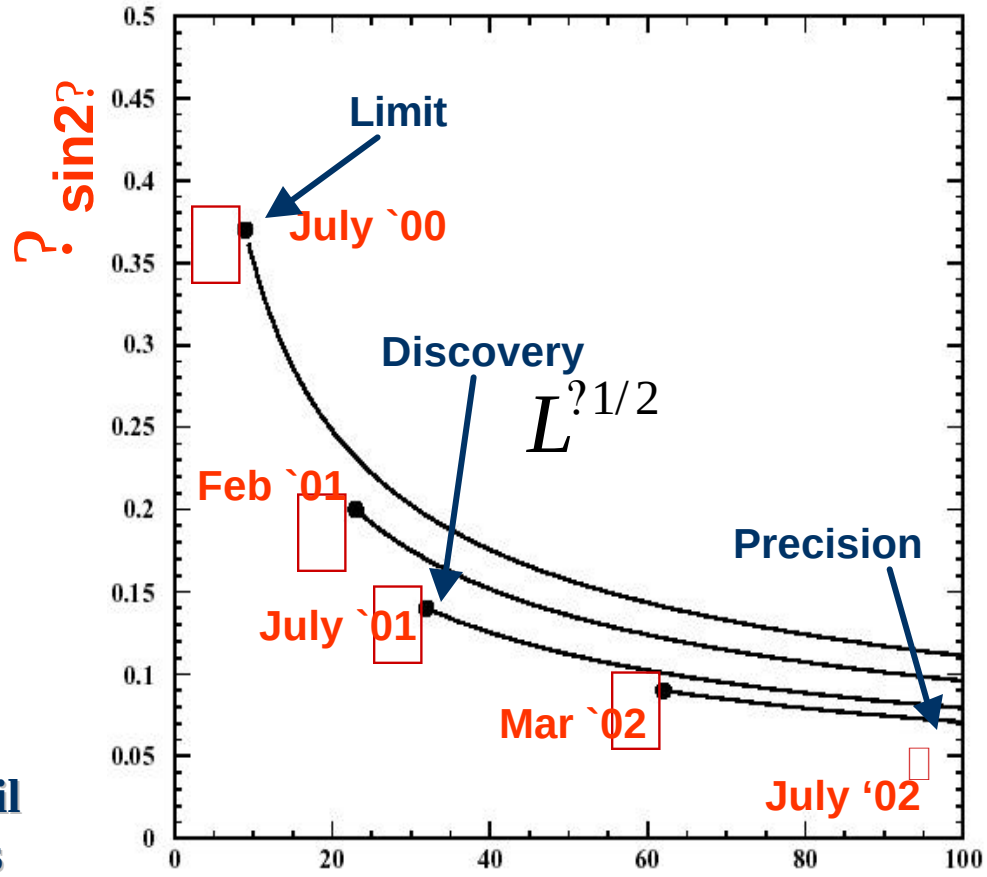
Semileptonic *B* decays (measure 1 side of triangle)

Constraints from mixing (? m_d and ? m_s)



Analysis Improvements

- **Steady improvements**
  - **Better statistics**
  - **Better understanding of detector**
- **In 2 years, limit ? discovery ? precision measurement**
  - **From a test of our understanding ? defining our understanding**
- **Many ever more stringent tests yet to come**
  - ***CP* violation in more complex decays**
  - **Rare *B* decays**
- **Rich source of physics at least until the end of the decade — 35 papers in publication**



Other Linac Downtime Work

1. **Collimators for Möller scattering experiment in End Station A (E158) were improved**
   - **Linac commenced running October 1, 2002. E158 will get 5 weeks of running (16 weeks were requested)**
   - **Linac performance has been excellent**

2. **Installed bunch compressor in sector 10 which shortens linac pulse by factor of 20**

E-158 Collaboration - Institutions

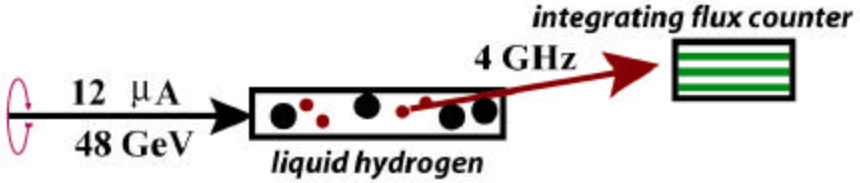
Caltech	*Syracuse University*
Princeton University	*Jefferson Laboratory*
SLAC	*UC Berkeley*
CEA Saclay	*UMass Amherst*
Smith College	*University of Virginia*

- 60 physicists from United States and France
- User groups funded mostly by Medium Energy Physics
- 3 B.S, 1 M.S. and 1 Ph.D. thesis on design
- 7 doctoral students on physics data

SLAC E-158

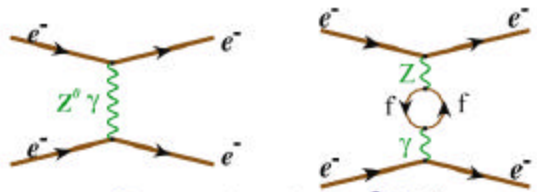
Left-Right Asymmetry in Fixed Target Moller Scattering

Goal: Most Precise Weak Mixing Angle Measurement at Low Q^2



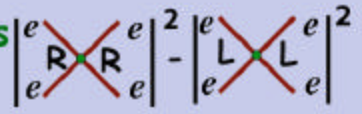
A_{LR} = 0.18 ppm

$\delta(A_{LR})$ = +/- 7% +/- 3%



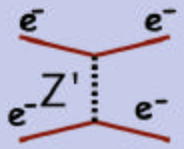
$g_{ee} \propto (1 - 4 \sin^2\theta_W)$

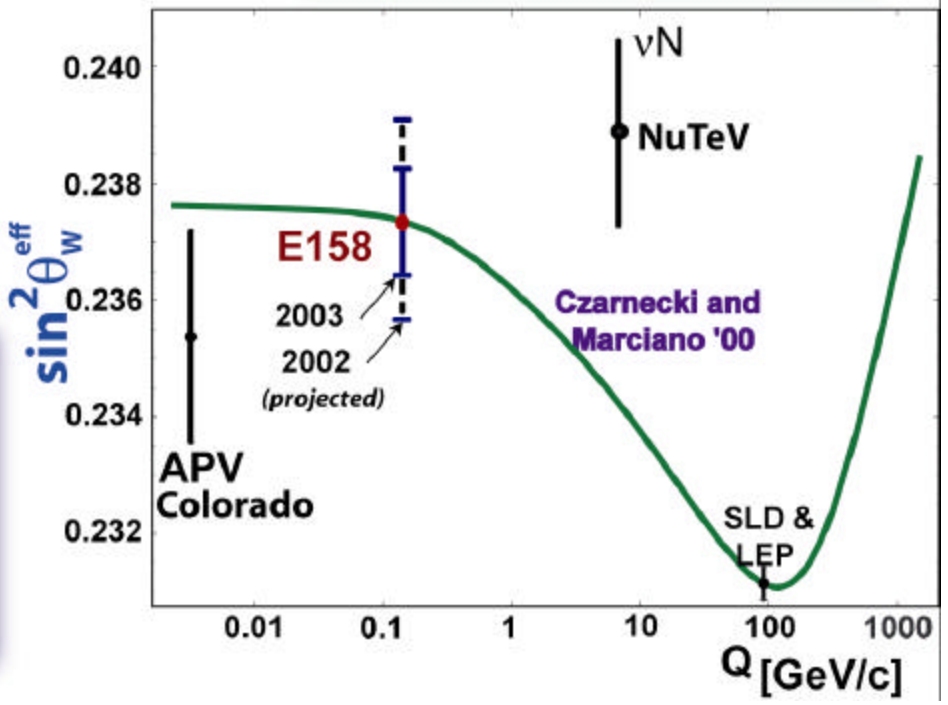
compositeness
$\Lambda \sim$ 15 TeV



New Physics

new forces
$M_{Z'} \sim$ 1.0 TeV



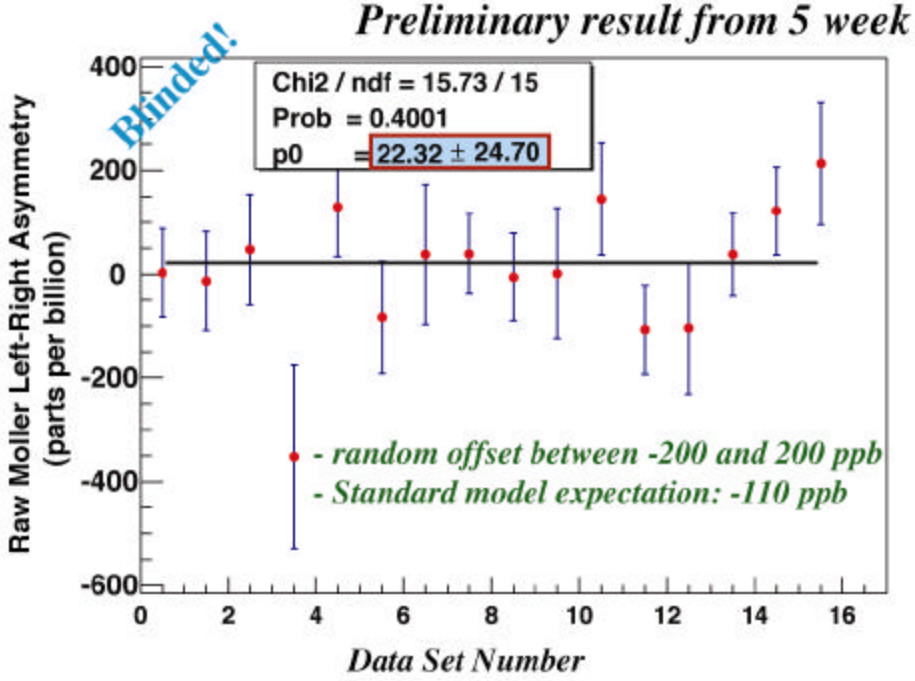


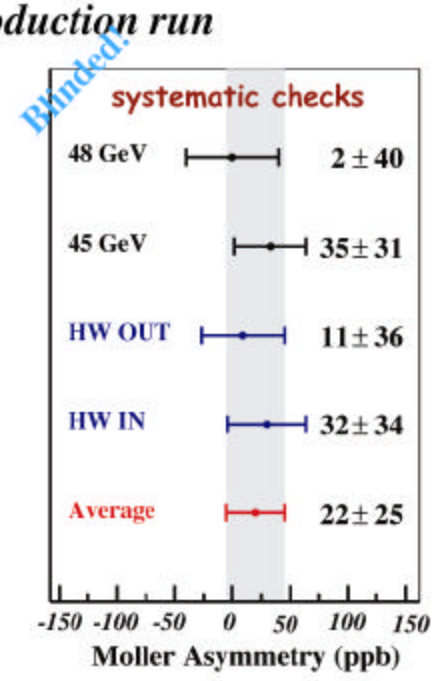
E-158 Status

- *Delivery of total beam power of 550 kW*
- *Unprecedented stability and accuracy*
- *Successful operation with PEP-II*
- *Run I: 5 weeks data run completed, May 03*
- *Run II in progress, data set will be doubled*
- *final run in late 2003*

Parameter	E158	NLC-500
Charge/Train	6×10^{11}	14.3×10^{11}
Train Length	270ns	260ns
Bunch spacing	0.3ns	1.4ns
Rep Rate	120Hz	120Hz
Beam Energy	45 GeV	250 GeV
e^- Polarization	80%	80%

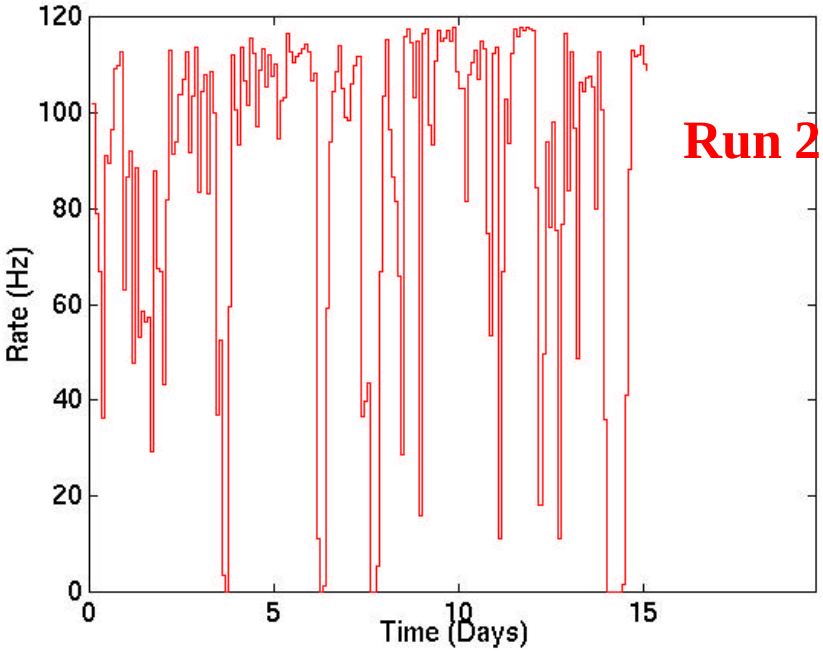
Preliminary result from 5 week production run





Comparison of E158 and NLC Beam Parameters

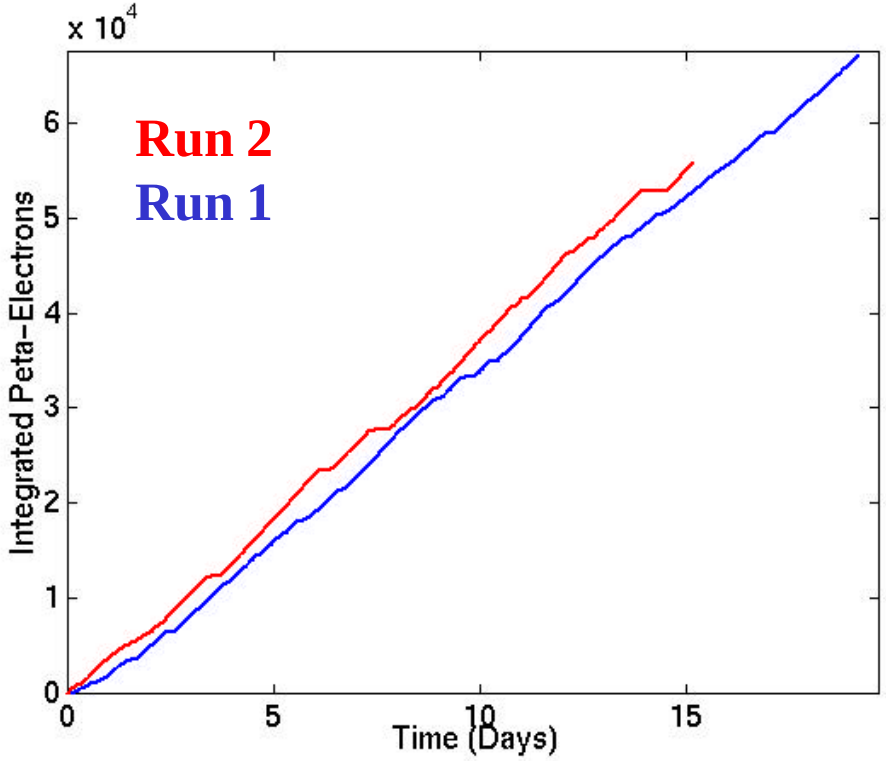
E158 Beam Delivery Run2

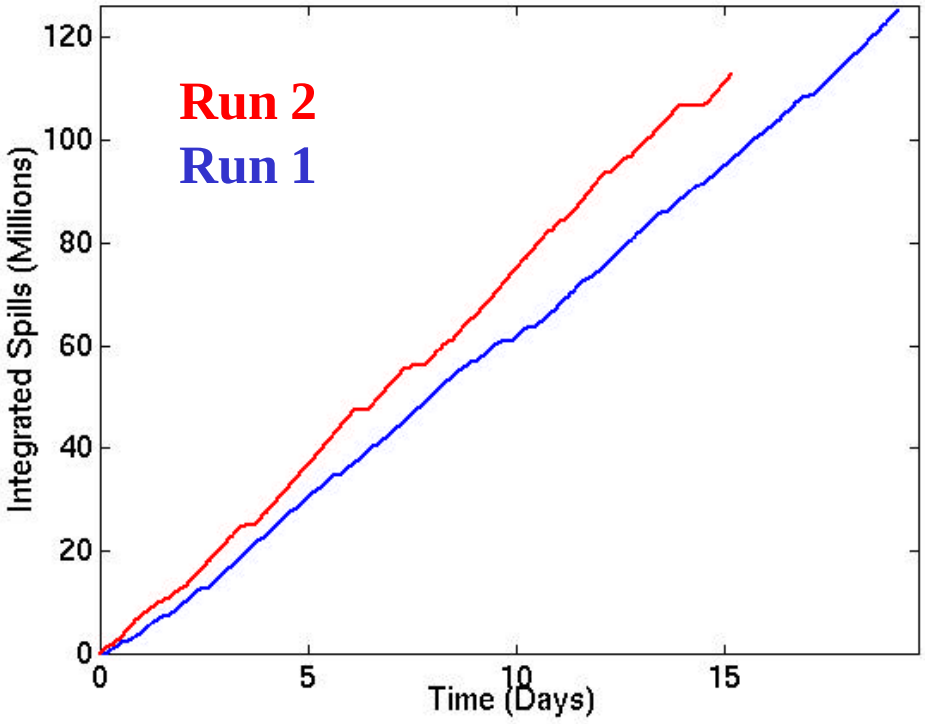


October 10 – November 15

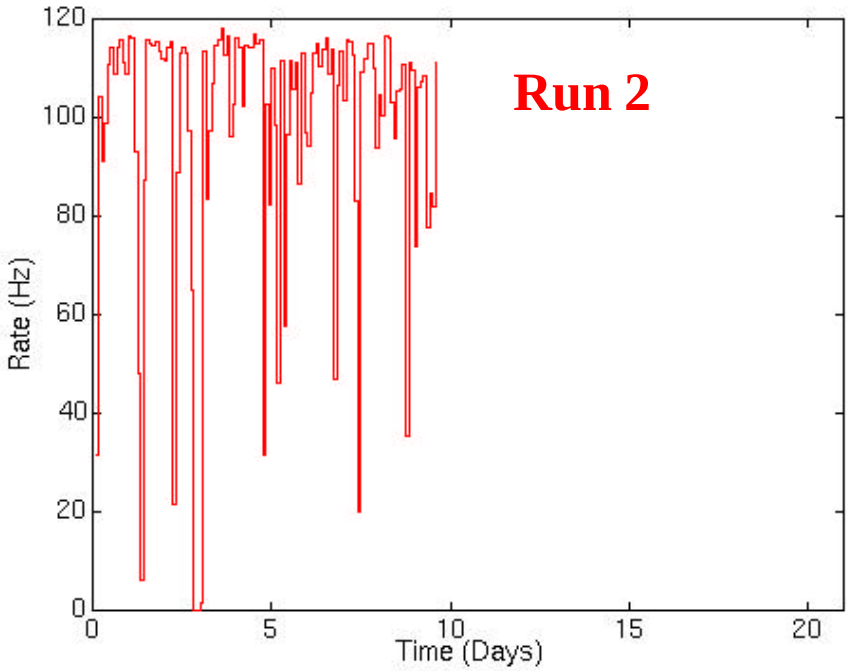
45 GeV Run 2 Data

October 10 – October 25





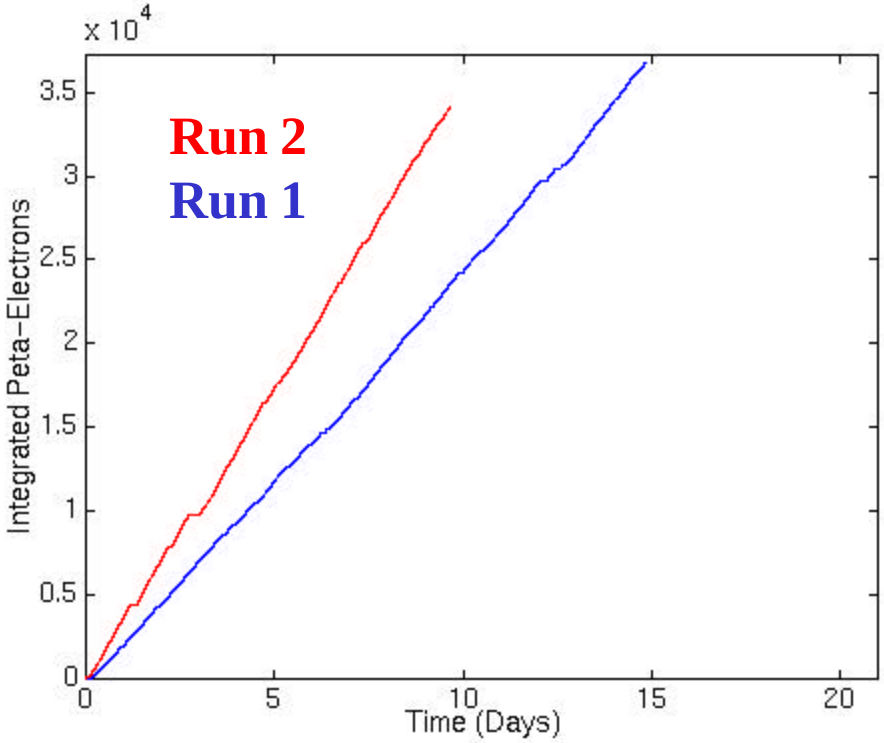
E158 Beam Delivery Run2

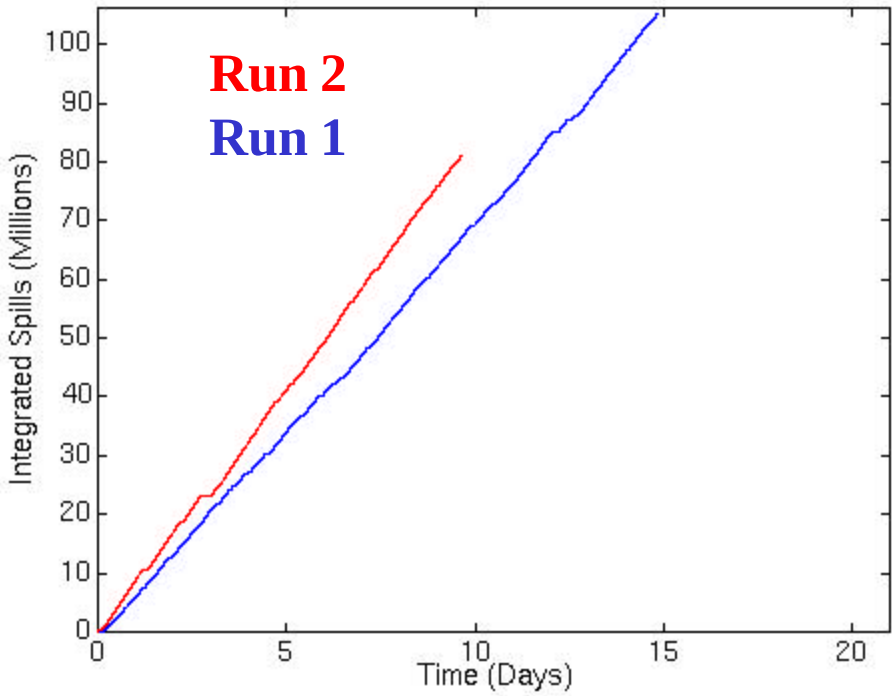


October 10 – November 15

48 GeV Run 2 Data

October 25 – November 15





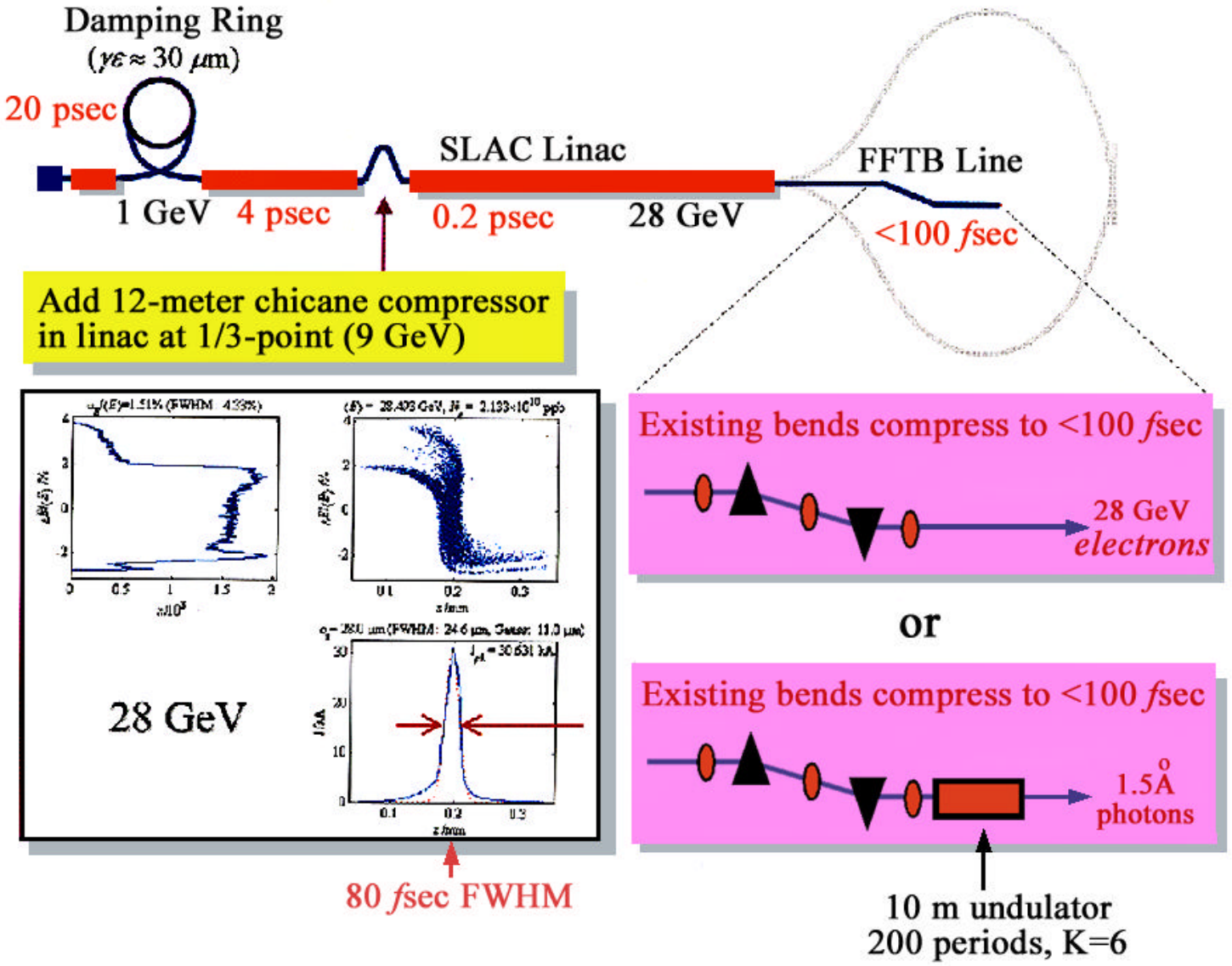
E158 Beam Delivery Summary for Runs 1 and 2

	Energy	#days @120Hz	# Peta-Electron	#spills	Average Charge	Production Efficiency*
Run 1	45.6 GeV	19.2	67K	125M	5.5×10^{11}	62%
Run 1	48.8 GeV	14.8	37K	105M	3.5×10^{11}	68%
Run 2	45.6 GeV	15.2	56K	113M	5.2×10^{11}	71%
Run 2	48.8 GeV	20	-	-	4.3×10^{11}	81%**

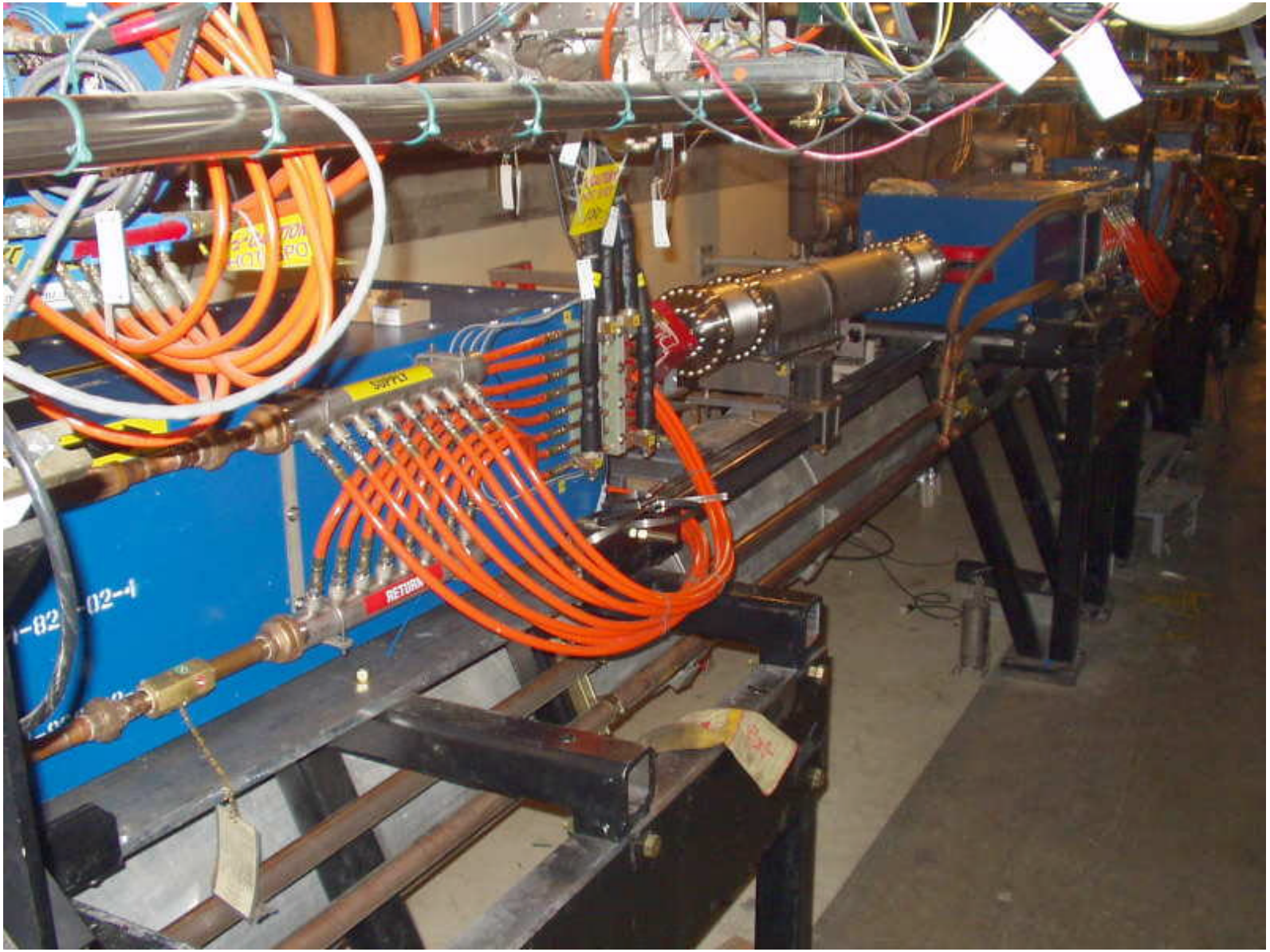
*Efficiency is avg. delivered rate normalized to 120Hz
**81% efficiency for first 9.5 days @ 48 GeV Run 2

Run 1: April 23 12:00 – May 28 00:00
Run 2: October 10 08:00 – November 15 08:00

Sub-Picosecond Pulse Source



4 Magnet Chicane in Sector 10



SLAC Beam Parameters — Pre and Post SLC

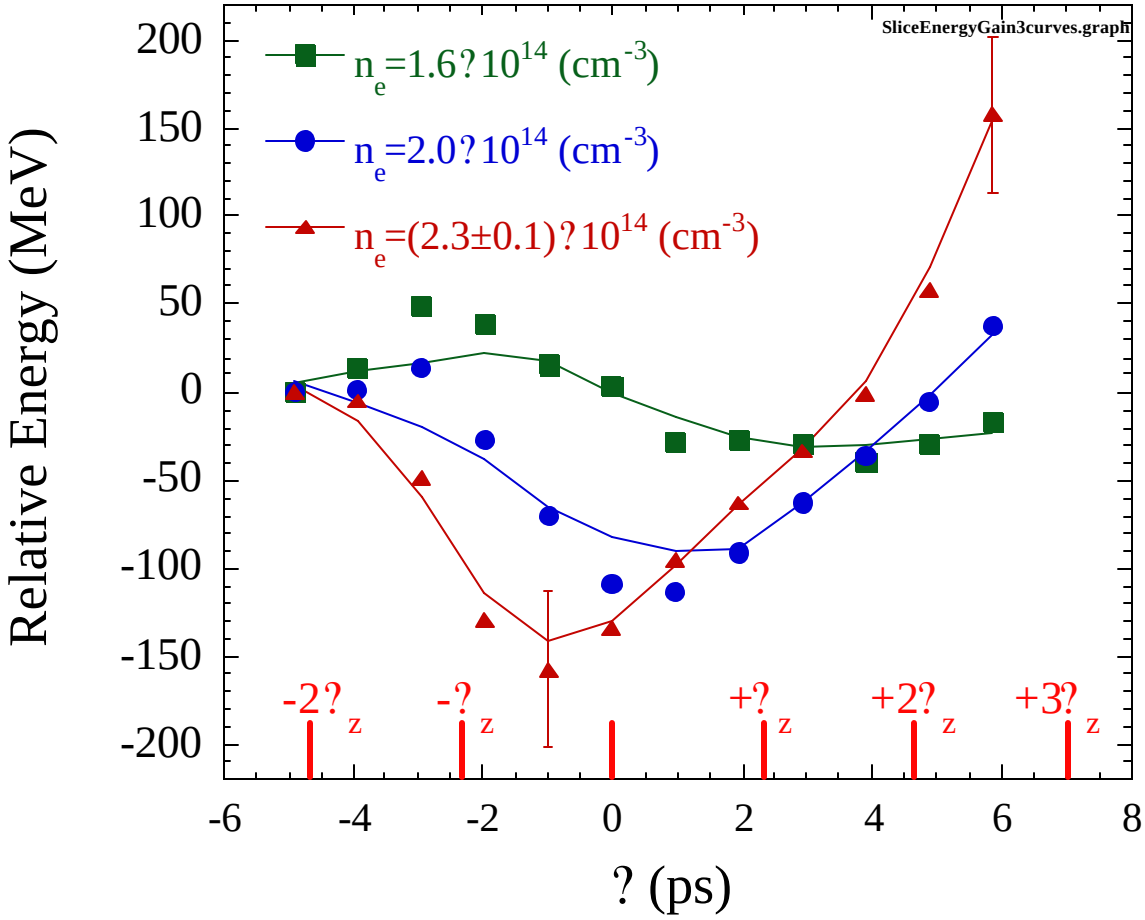
SLAC LINAC FFTB BEAM BEFORE-AFTER SLC+SPPS SPECIFICATIONS J. Seeman, R. Erickson 14-Oct-02

Parameter	Units	Electrons Before SLC	Electrons After SLC	Electrons After SLC+SPPS	Positrons Before SLC	Positrons After SLC
Energy (E)	GeV	30	47	28	20	47
Particles per bunch (N)	x 10**8	10	400	400	0.33	390
Bunch length (sigz)	mm	3	0.5	0.025	4	0.5
Horizontal invariant emittance	m-rad	3.00E-04	4.00E-05	4.00E-05	2.00E-03	5.00E-05
Vertical invariant emittance	m-rad	3.00E-04	6.00E-06	6.00E-06	2.00E-03	3.00E-06
Absolute horizontal emittance at linac end	m-rad	5.11E-09	4.35E-10	7.30E-10	5.11E-08	5.44E-10
Absolute vertical emittance at linac end	m-rad	5.11E-09	6.52E-11	1.10E-10	5.11E-08	3.26E-11
Average x or y beta function at linac end	m	200	35	35	200	35
Average x beam size at full energy (sigx)	microns	1011	123	160	3197	138
Average y beam size at full energy (sig y)	microns	1011	48	62	3197	34
Energy Density=E*N/sigx/sigy/sigz	GeV/?**2/mm	9.78E+03	6.38E+08	4.53E+09	1.61E+01	7.87E+08
Ratio of energy density after-to-before			65184	462692		48721729

In addition: Polarization was increased from 42% to 80%
Fill rate for PEP ring increased from 7 to 720 mamps/min

E-162: Use Imaging Spectrometer To Measure Energy Loss & Gain

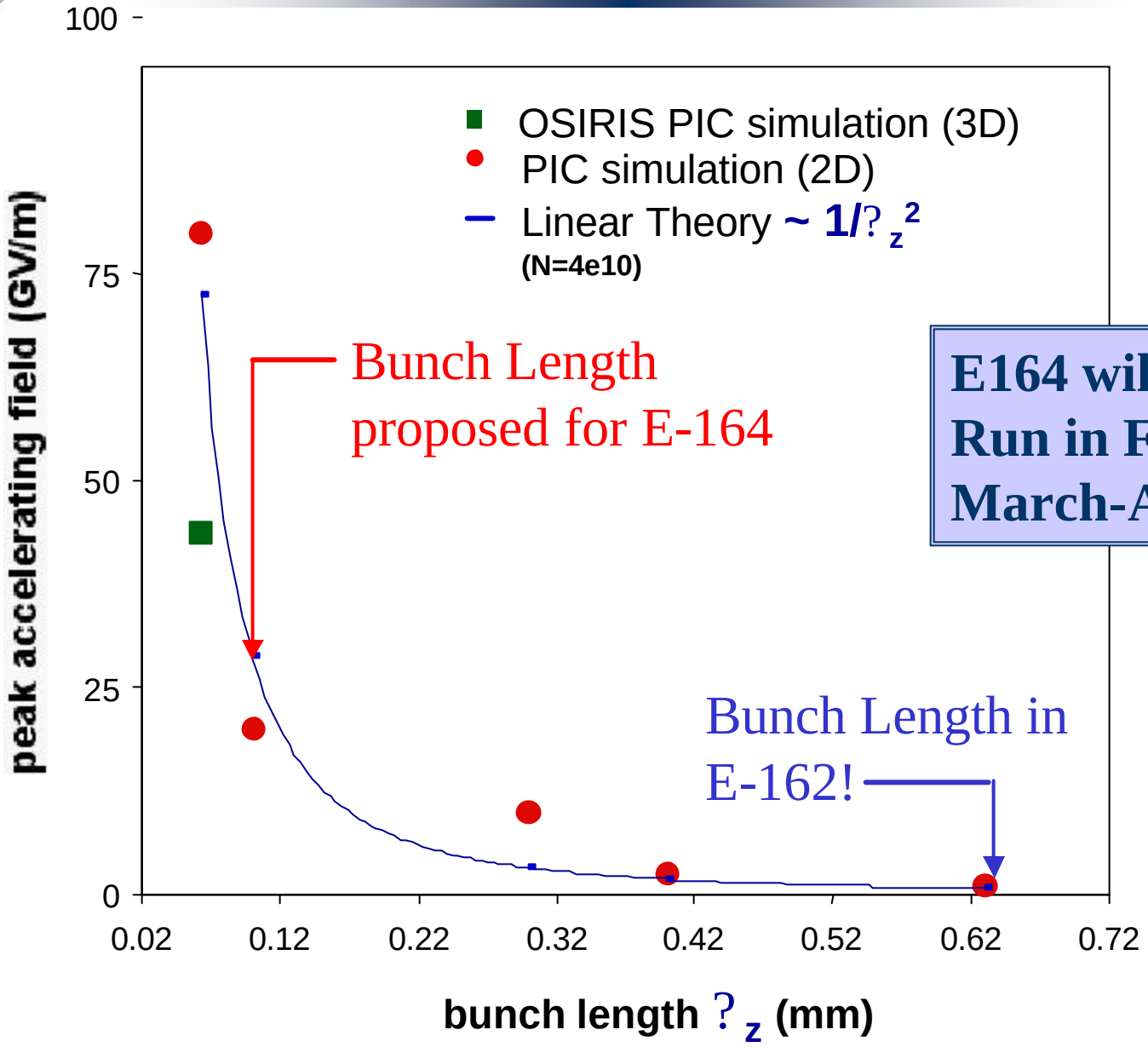
Picosecond Gaussian Slice Analysis of Many Events



- Average energy loss (slice average): 159±40 MeV
- Average energy gain (slice average): 156 ±40 MeV

(~ 1.5?10^8 e^-/slice)

Do plasma wakes scale as $1/\lambda_z^2$?



E164 will Run in FFTB March-April 2003

FY03 – A Challenging Budget Year

- **SLAC budget for FY2003 is $0.7M less in dollars than our FY 2002 budget**
  - **Absence of inflation compensation presents the Laboratory with a major challenge**
- **Dealing with this challenge has required a plan that**
  - **Makes cutbacks in all the program elements**
  - **Relies in addition on staff-related cost saving measures**

SLAC Electrical Power Costs
(Dollars in thousands)

	FY1999	FY2000	FY2001	FY2002	Est FY2003
Site Power	610	574	670	865	975
HEP Power	5,023	5,090	5,993	7,872	9,568
Total Power	**5,633**	**5,664**	**6,663**	**8,737**	**10,543**

Proposed HEP Program Cuts for FY03

- We will do our best to keep the *B* Factory running as close to 38 weeks as the budget will allow. However we are forced to reduce the spending on the *B* Factory machine upgrade by about $3.5M
- E158 in ESA will only run 5 weeks instead of their requested 16 weeks
- Construction of the photon beamline for the next 3 approved ESA experiments is completely halted. Design of the first experiment is halted. This may portend the cancellation of these experiments
- Funding for the NLC R&D will be below expectations
- All the M&S budgets supported by HEP have been squeezed very hard
- Routine upgrading of desk-top computers will be deferred for a year
- Routine purchases of furniture will be deferred for one year

Staff-related Measures for FY03

- **Based on our current expectations for the FY03 budget, three staff-related measures are required**
- **Voluntary layoff program**
  - **This program is available to all staff**
- **All HEP-funded staff to take vacation during FY03 equal to at least the vacation earned during FY03**
- **All HEP-funded staff to take leave without pay next September 2,3,4 and 5**
  - **This represents a 1.5% reduction in take-home pay for the year, but does not change the employee's base salary**

SLAC User Lodging
Entrance View

SLAC User Lodging
Courtyard View

SLAC User Lodging
Construction Progress – 11/05/02